

94 A Meeting of Minds



Plenty of fossil evidence shows that most of the species that have lived in the past are no longer alive today. It also seems that most of the species on Earth today were not always here. In other words, different species of organisms have lived at different times in Earth's history. New species have descended from earlier species, but have changed over long periods of time. These changes through time are called **evolution**.

But how does evolution happen? Two major theories were proposed during the 19th century. The first was disproved and abandoned, while the second has helped evolution become a central idea in modern biology. What would it sound like if the original experts met and discussed the problem?

CHALLENGE



How does evolution happen?

MATERIALS



For each student

- 1 Student Sheet 94.1, "Intra-act: A Meeting of Minds"



PROCEDURE

1. Assign a role for each person in your group. Assuming there are four people in your group, each of you will read one role.

Roles

Charles Darwin, 19th century scientist

Isabel Matos, science reporter for Station W-EVO

Jean-Baptiste Lamarck, 19th century scientist

Wendy Chin, middle school student

2. Read the role play on the next pages aloud. As you read, think about what each character is saying.
3. Mark whether you think scientists today would agree or disagree with the statements on Student Sheet 94.1, “Intra-act: A Meeting of Minds.”
4. Discuss the statements with your group.

HOW DO SPECIES EVOLVE?

Isabel Matos: In today’s episode of “Time Travel News,” we have brought together two of the first scientists to publish ideas on how evolution occurs. Visiting us from the 19th century are Jean-Baptiste Lamarck and Charles Darwin. Monsieur Lamarck, let’s start with you.

Jean-Baptiste Lamarck: I was one of the first to recognize that species evolve. In 1809, I proposed the first theory of how evolution occurs. Allow me to explain my theory. Let’s begin by talking about giraffes. Wendy, why do you think giraffes have such long necks?

Wendy Chin: To reach leaves at the tops of trees, I guess. They have to be able to get food.

Lamarck: Quite right. I began to wonder how giraffes’ necks became so long.

Wendy: I bet they evolved that way.

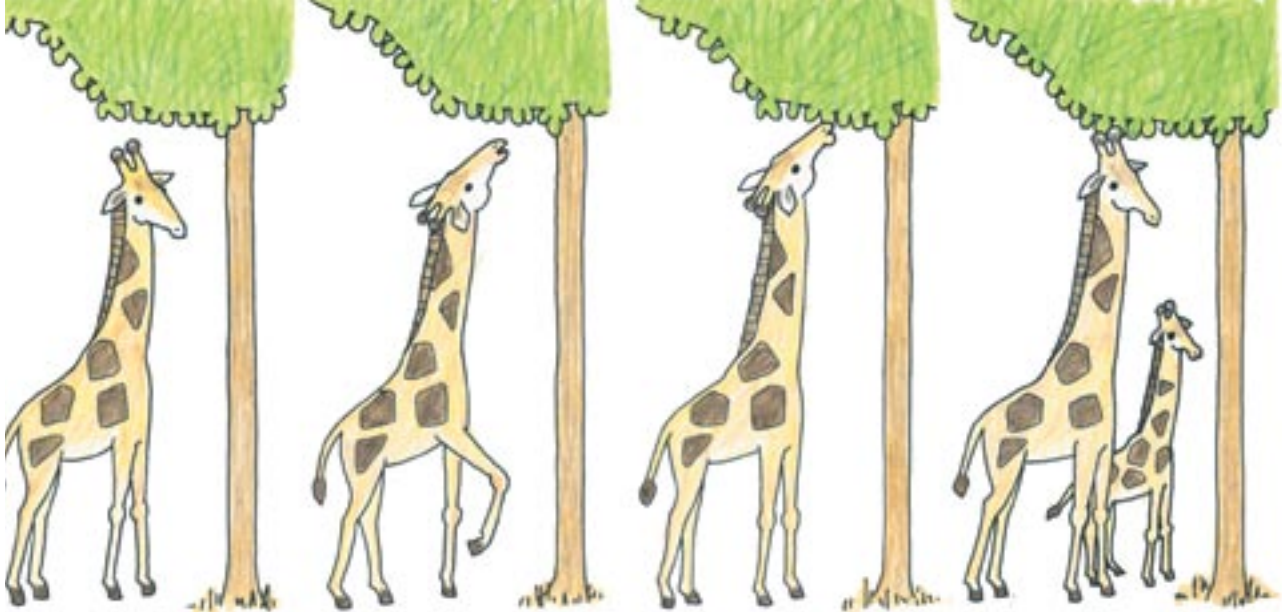
Lamarck: But how did this evolution occur? This is what I wanted to understand. My theory was that giraffes stretched their necks by reaching for leaves that were higher and higher on the trees. This made their necks longer.



Activity 94 • A Meeting of Minds

Then, when they had babies, their babies had longer necks too. Look—this sketch helps explain my ideas.

LAMARCKIAN EVOLUTION



This is an adult giraffe.

The giraffe reaches for leaves slightly out of reach.

The use of the neck causes it to lengthen slightly.

The offspring of the giraffe also has a longer neck.

Wendy: Shouldn't a theory be based on evidence?

Matos: Mr. Lamarck, did you ever see an adult giraffe grow its neck longer?

Lamarck: Of course not. My idea was that the growth was very small, too small to measure in one generation.

Charles Darwin: I'd like to explain another theory, called natural selection. Alfred Russel Wallace and I constructed this theory at about the same time. We also noticed that not all animals of the same type have the same features. Take horses, for instance.

Wendy: Oh, I know what you mean! There are horses of different sizes and colors, but they are all one species and can interbreed.

Darwin: Exactly—and the same is true of giraffes. Have you noticed that animals in the same species look different, or varied? This is important because, in the wild, some animals in each species usually die every year. Only animals that survive can give birth to offspring. Now, what feature of a giraffe might help it to survive and live to reproduce?

Lamarck: Its neck, of course! As I said before, it must stretch from being used so vigorously. Giraffes can then pass on the longer necks to their children.

What differences do you observe in these giraffes of the same species?



- Matos: But Mr. Lamarck, modern scientists have found no evidence for your hypothesis that parents can pass *acquired* traits to their offspring. Consider professional wrestlers. They build muscles by lifting weights. But their babies are no stronger than other babies. If these babies want to have muscles like their parents, they have to pump a lot of iron too!
- Darwin: But just like human babies, not all giraffes are the same. They have slight differences in all their characteristics, including neck length.
- Lamarck: So you're saying any giraffe that happens to have a slightly longer neck can eat leaves that are higher in a tree than a shorter-necked giraffe can and therefore is more likely to survive.
- Wendy: So the longer-necked giraffes are more likely to live longer because they can reach more food. If more of these giraffes live longer, they can produce more offspring!
- Darwin: That's right. Animals with certain features, such as giraffes with longer necks, are more likely to live to adulthood and have more babies. We call that process **natural selection**. Here's a sketch of how it works

DARWINIAN EVOLUTION (NATURAL SELECTION)



Giraffes with longer necks tend to reach leaves more easily.



Longer-necked giraffes are more likely to eat enough to survive . . .



. . . and reproduce. The offspring inherit their parent's longer necks.

- Wendy: But why will the offspring of longer-necked giraffes have longer necks too?
- Matos: Well, tall parents are more likely to have tall children, aren't they? The same is probably true of giraffes.
- Darwin: According to my theory, each new generation of giraffes has, on the average, slightly longer necks than the generation before.
- Lamarck: But not because they stretched their necks? Only because the longer-necked giraffes were more likely to survive and reproduce?
- Wendy: I get it. Individual animals don't change, but over very long periods of time, the population of an entire species does.
- Lamarck: But, Mr. Darwin, can your theory of natural selection explain why extinction occurs?
- Darwin: I believe so. Consider the mammoth, which became extinct a few thousand years ago. Why didn't mammoths evolve and continue to survive?
- Wendy: There are several theories about that. They became extinct during a time when the global climate was warmer than it had been before. The changing climate may have affected the mammoth's food supply, and human hunters may have contributed to the extinction.
- Matos: So a species becomes extinct when it doesn't survive an environmental change. No individuals in the population have the traits necessary to survive.
- Darwin: That's all it is. The **variation** in the population isn't enough to withstand environmental changes. In fact, sooner or later, most species become extinct.
- Wendy: Let me get this straight. As time passes, species change, and we call this evolution. The way this occurs is by natural selection—some individuals in a population happen to be better suited to the environment and they're more likely to survive and reproduce.
- Lamarck: As a result, the population as a whole over many generations comes to have an **adaptation**, such as a giraffe's longer neck.
- Matos: Today, we know that we pass on characteristics like longer necks to our offspring through genes. Genes don't change because you exercise your neck.
- Darwin: Tell us more about these genes.
- Wendy: I learned about genes in school. Genes are things in our cells that we inherit from our parents. They cause us to have traits—the way we look and stuff.
- Lamarck: Fascinating. I would like to learn more about this.
- Darwin: Without this modern evidence, I hesitated to publish my theory for years, until Wallace sent me a brief paper containing the same ideas. Within a few years of our publications, scientists widely accepted the idea that species arise by descent with modification, or evolution.
- Matos: Thank you, Mr. Lamarck and Mr. Darwin. Viewers, I hope you've enjoyed meeting people from our past. Join us next week for a scintillating conversation with Marie Curie, the first woman scientist to receive a Nobel Prize.

ANALYSIS



1. **a.** Compare and contrast Lamarck's and Darwin's theories of evolution: What are the similarities? What are the differences?

b. Why do scientists find Darwin's theory more convincing?



2. Ancestors of modern elephants had much shorter trunks than elephants do today. Use Lamarck's theory of evolution to explain how the trunks of elephants might get longer over many generations. Drawing a picture may help you to explain what you have learned.



3. Use the Darwin/Wallace theory of natural selection to explain how the trunks of elephants might get longer over many generations. Drawing a picture may help you to explain what you have learned.

4. **Reflection:** When antibiotics were first used, antibiotic-resistant bacteria were rare. Today antibiotic resistance is becoming more and more common. How is the problem of antibiotic resistance in bacteria an example of natural selection?